DOCUMENT RESUME

ED 326 593 UD 027 763

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TITLE Minorities in Engineering School: A Data Base for Retention Efforts. NACME Research Letter. Vol. 1, No. 1.
INSTITUTION National Action Council for Minorities in Engineering Inc., Washington, DC.
PUB DATE Apr 90
NOTE 5p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Academic Achievement; American Indians; *Black Students; *College Attendance; College Students; *Educational Environment; *Engineering Education; Higher Education; Hispanic Americans; Intervention; Minority Groups; National Surveys; Program Development; Questionnaires; *School Holding Power
IDENTIFIERS African Americans; *Hispanic American Students

ABSTRACT

The National Action Council for Minorities in Engineering (NACME), in cooperation with the Center for the Advancement of Science, Engineering and Technology (CASET), undertook a national survey of underrepresented minority students in engineering to assess their college experiences in relation to academic performance. Professionals at the college level need a sound empirical basis for designing intervention programs aimed at increasing the number of minority students who graduate from engineering programs. The purpose of this study was to provide that data. A 95-item survey instrument was sent to 2,584 African American, Hispanic, and American Indian students enrolled full time in undergraduate engineering programs at 64 colleges and universities. The survey results are based on responses from 1,206 students. Selected questionnaire items reveal important facts and trends about the students, their perceptions of engineering programs, and their college success. Implications for retention and predicting grade point averages are discussed. The report recommends the following actions: (1) increase scholarships and grants for minority engineering students; (2) establish additional minority engineering support programs; (3) expose students to scientists and engineers at an early age; (4) provide faculty with training in cultural differences; and (5) reduce ethnic conflict on campus. The report includes six graphs and one table. (AF)

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NACME

April 1990 Volume 1, Number 1

Research Letter

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Minorities in Engineering School

A Data Base for Retention Efforts

by Douglas L. Friedman, Ph.D.

It is now widely acknowledged that engineering shortages threaten the United States' ability to compete in world markets that are increasingly dominated by high technology products. Changing demographics and waning interest in the profession among white males, the historic pool from which engineers have been drawn, intensify the need to educate populations not typically participating in the field in order to meet future demand.

From 1973 to 1989, the number of underrepresented minorities (African Americans, Hispanics and American Indians) obtaining bachelor of science in engineering (BSE) degrees increased nearly 250%. However, parity remains an elusive goal. Until representation of those groups in the engineering field reflects their numbers in the total population, efforts to offset national shortages will remain insufficient.

Introduction

Engineering Manpower Commission data show an upsurge in minority enrollments in recent years. However, retention of minority students remains a significant challenge. For example, nominal four-year retention rates indicate that minority students drop out at about twice the rate of all other engineering students.

Numerous retention studies in higher education have correlated student success in college, across disciplines, to a number of environmental factors. However, until this report, no major study had examined the performance of underrepresented students in engineering, relating their educational experiences and background variables.

NACME, in cooperation with the Center for the Advancement of Science, Engineering and Technology (CASET), undertook a national survey of underrepresented minority students in engineering to assess their college experiences in relation to academic performance. Professionals at the college level need a sound empirical basis for designing intervention programs aimed at increasing the number of minority students who graduate from engineering programs. *The purpose of this study was to provide that data.*

Survey Design

In the fall of 1988, a 95-item survey instrument was sent to 2584 African American, Hispanic and American Indian students enrolled full time in undergraduate engineering programs at 64 colleges and universities. The survey results are based on responses from 1206 students.

Counts and frequencies of responses to the individual questionnaire items were studied first. Next, items were clustered in nine underlying themes or factors based on the student responses. These factors, coupled with the students' background variables, were then correlated with a measure of student success.

Student Views

Selected questionnaire items reveal important facts and trends about the students, their perceptions of engineering programs, and their college success:

General Background

- The parental level of education was not as high as the national sample of all SAT test takers (see Figure 1).
- The mean mathematics SAT score of the students was comparable to that of white and Asian engineering students nationally, but considerably higher than that of all underrepresented minority students in engineering.
- Significantly more of the students lived off campus than the national average for all college students.

Choosing Engineering

- Seventeen percent of the students identified ethnic group representation on campus as an important factor in their college choice. Overwhelmingly, African American students (86%) attached importance to this factor.
- More than four-fifths of the students (81%) were attending institutions of their first or second choice.
- Students' career decisions were most strongly influenced by their own interests/aptitudes, perceived job opportunities, and salaries (see Figure 2).
- More than half of the sample (54%) was not influenced by friends, professional engineers, or a campus visit. Close to three-fourths of the students (74%) claimed not to be influenced by science fairs or media, and nearly as many (63%) were not influenced by industry. Almost a third (30%) were not influenced by family.
- Nearly half of the students (49%) said that high school counselors did not influence their career decision. In fact, students identified high school counselors, more than any other factor, as a negative influence.

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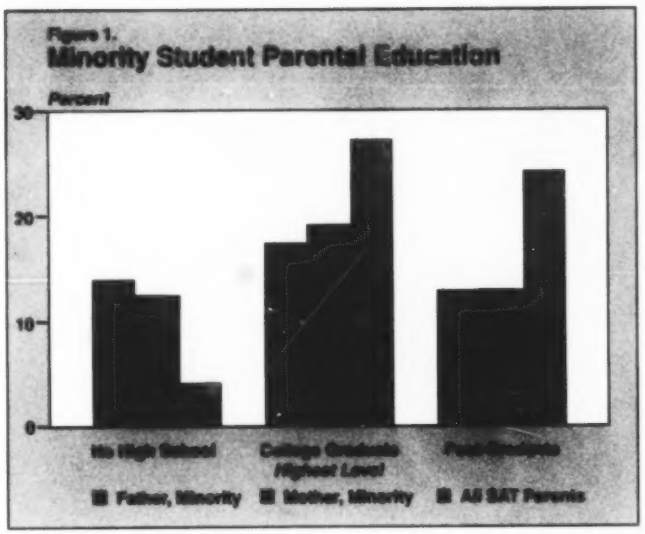
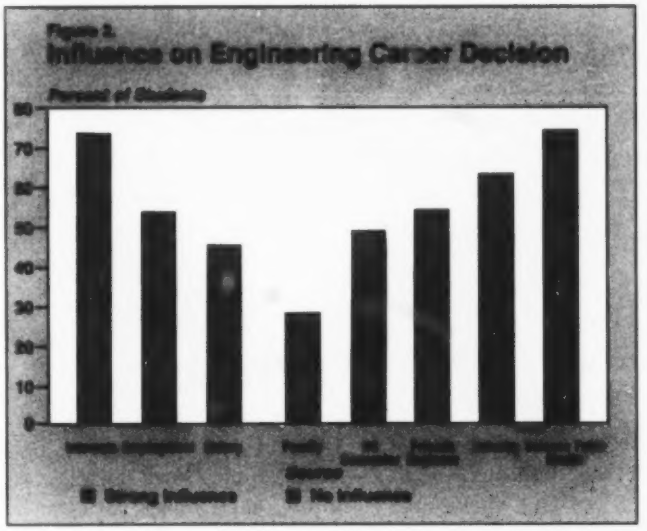




Financial Need

- More than one-half of the students (56%) indicated meeting the cost of college was a problem, and almost a third of these (30%) revealed that the problem was serious.
- For most students, financial support came from a number of sources, with no one source predominating.
- The most frequently cited sources of financial support were summer employment, college employment and NACME scholarships. Large numbers of students received no support from their families (38%) and had no loans (52%) (see Figure 3).

College Environment

- The most helpful source of academic/social support was peers/friends, cited by more than half of the students (54%). Professional and other student organizations were cited as "moderately helpful" by many students (69%).
- A significant fraction of the students (15%) felt that the minority engineering program (MEP) staff was not a source of support. Also, non-minority faculty members and faculty advisors were not "very helpful."
- Individual MEP services, such as orientation and academic monitoring were frequently used and rated as helpful. However, large percentages of students rated placement assistance and tutoring as "helpful" and "not helpful."

Success Factors

- Nearly four-fifths of the sample (79%) indicated satisfaction with their major, college choice, basic reading and mathematics/science skills.
- Almost one-half of the sample (45%) faced special problems as minority students. African Americans were significantly more likely (84%) than Hispanics (16%) to be in this group (see Figure 4).
- Nearly half of the students (49%) had never been taught by a minority faculty member, excluding foreign nationals (see Figure 5).

Implications for Retention

Performance data, such as SAT scores, and information from self-evaluation items, reveal that students in this survey are highly motivated and academically competent. However, they face special problems as minority students and have financial difficulties that may interfere with their performance. In comparison with college freshmen nationally, 78% of whom received some financial support from their families in 1988, significantly fewer students in this survey (61%) received such support.

Based on the survey data, traditional sources of support are lacking for minority students interested in engineering. There is a dearth of engineering role models, and high school counselors are not directing qualified minority students towards professional careers in engineering.

The students surveyed relied more on peers and friends for academic and social support than on any other traditional sources.

Importantly, while many students found such MEP services as tutoring and placement assistance useful, many others chose not to use them. This could reflect either differences in the quality of such services across institutions, or differential needs among students for these services. In either case, a comprehensive analysis of MEP programs would be helpful in identifying effective components and areas where additional resources are required.

Predicting Grade Point Average

One measure of success in college engineering programs is a student's grade point average (GPA). Our goal in this phase of the analysis was to relate items in the survey instrument to students' GPAs.

First, the 95-item questionnaire was reduced by statistically clustering items into nine underlying factors. These are listed in Table 1, along with their definitions. Next, these factors and relevant student background variables were analyzed using multiple regression techniques to determine their ability to predict college GPA.

Four of the factors and two background variables contributed significantly to predicting GPA. In order of importance, high college GPA is

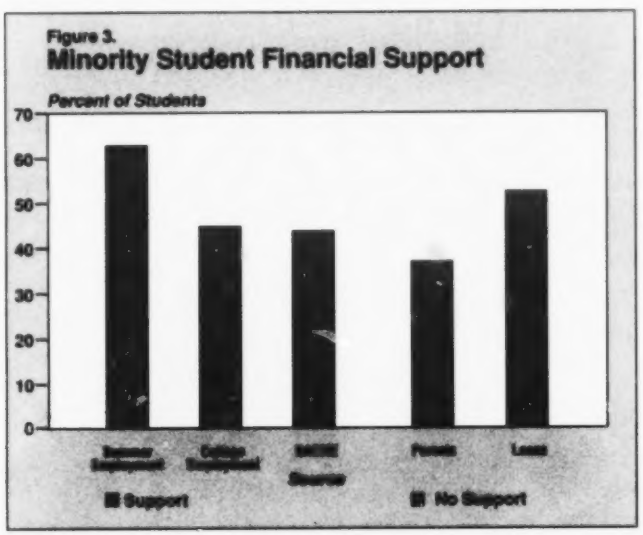
associated with: (1) stronger student commitment to the university, (2) better high school GPA, (3) higher mathematics SAT scores, (4) less financial need, (5) greater minority presence on campus, and (6) better precollege preparation (see Figure 6). Ongoing MEP services, academic integration, goal commitment, social integration, and MEP crisis support, as well as gender, did not add significantly to the ability to predict GPA.

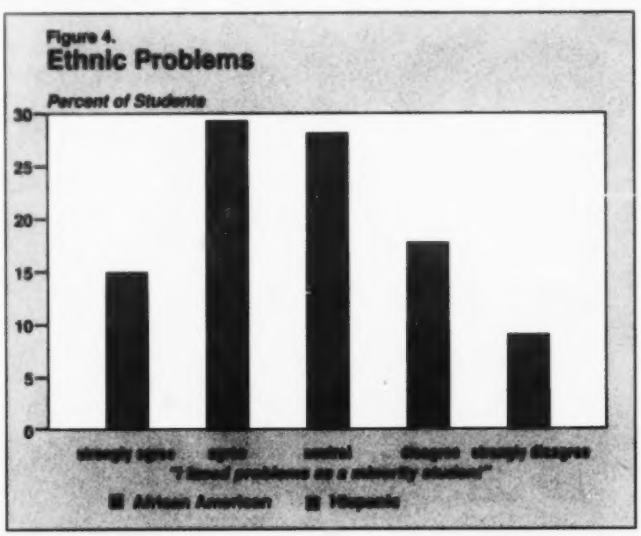
Nearly one-fifth (18%) of what determines students' GPA could be accounted for by the six significant predictor variables cited above. Although this is a modest percent of the total GPA, given the vagaries of predictive analyses, it represents substantial capabilities.

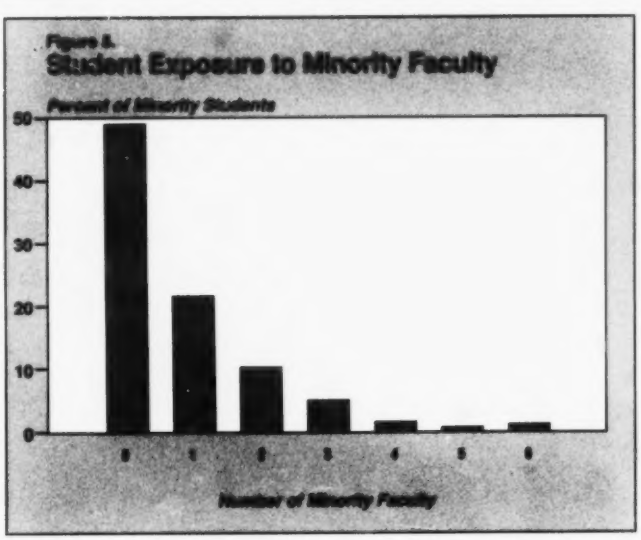
Action Steps

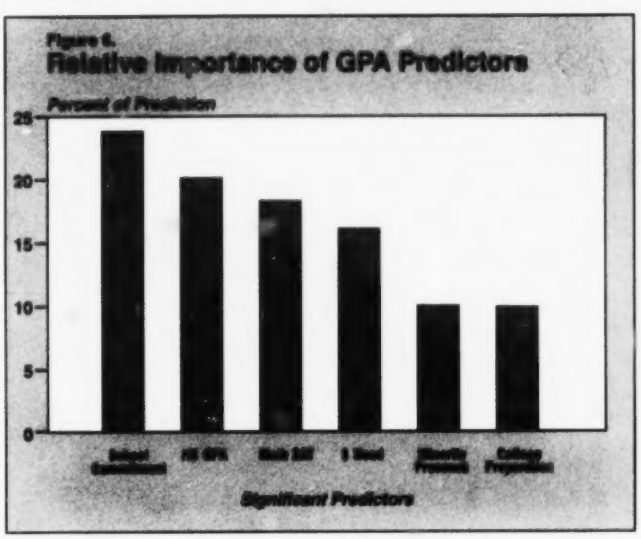
The survey findings indicate that there are several courses of action which need to be taken to increase minority representation in engineering.

- Increase scholarships and grants to attract and retain minority engineering students. This study found that students with fewer financial concerns had higher GPAs.
- Establish additional minority engineering support programs at the college level. However, existing programs need to be evaluated to determine their effectiveness in retaining students.
- Expose students to scientists and engineers at an early age in order to motivate them to consider technical careers. This study revealed that many students are not exposed to engineers as role models.
- Provide faculty with training in understanding cultural differences. Faculty can be a positive influence on student performance, as well as a crucial factor in minority student retention.
- Reduce ethnic conflict on campus. Such problems negatively influence students' commitment to the institution, which is key to academic performance. The comfort level on campus can be raised by increasing the number of minority students and faculty in engineering programs.









This study provides a snapshot of minority students' current experiences in engineering programs. However, the findings cannot be definitively related to success or lack of success in earning a degree. Other research is needed to relate student experiences and preparation for college to ultimate academic outcomes. NACME is currently conducting an attrition study that addresses these issues. Findings can be applied to developing stronger support systems for retaining and graduating underrepresented minorities in engineering.

The findings in this report are part of the research being conducted under Department of Defense Grant DAM17-88-Z-8013 with support from the National Aeronautics and Space Administration (NASA)/ Johnson Space Center. The views, opinions and/or findings it contains are those of the author and should not be construed as an official Department of the Army, Department of Defense, or NASA position, policy or decision, unless so designated by another documentation. NACME wishes to thank the Minority Engineering Program Directors at the participating postsecondary institutions, and the minority engineering students for their cooperation in this research.

Table 1.
Factor Analysis

Factor	Definition
Ongoing MEP Support	**student usage and satisfaction with MEP services designed to support academic and social development on an ongoing basis**
Preparation for College	student satisfaction with preparation for college
Academic Integration	**students' integration into and satisfaction with the academic environment**
Commitment to the University	students' general satisfaction with various aspects of college life
Goal Commitment	**beliefs about certainty of completing BSE degree**
Social Integration	student activities outside the classroom
Crisis MEP Support	**student satisfaction with MEP services that supported them in an emergency**
Minority Presence	academic and social contact with minorities on campus
Financial Need	**degree of difficulty in financing college education**

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